

# Dynamic Selection of Three-Dimensional Interface Patterns in Directional Solidification (DSIP)



**U.S. PI:** Prof. Rohit Trivedi, Iowa State University  
**ESA PI:** Dr. B. Billia, Université Paul Cézanne, Marseille, France  
**PS:** Dr. Donald C. Gillies NASA MSFC

**Marshall Space Flight Center**

## Objective:

- ◆ Understanding of dendrite evolution has been dramatically increased by microgravity experiments, principally in undercooled pure materials.
- ◆ Understand the dynamics that lead to uniform and reproducible three-dimensional pattern formation in materials, particularly alloys
- ◆ Obtain benchmark data required for establishing the detailed dynamics of interface pattern selection during the solidification of alloys.
- ◆ A fundamental understanding of interface dynamics is central to tailor microstructures to optimize materials properties.

## Relevance/Impact:

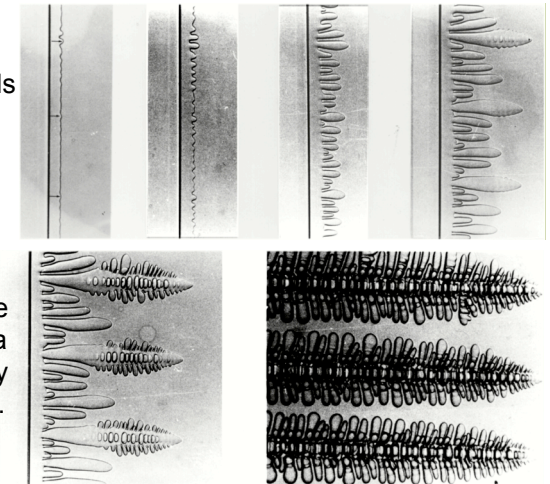
- ◆ Many industrial applications involve directional solidification.
- ◆ Pattern formation is vital for controlling microstructure during solidification of high temperature, high strength, complex alloys, and in welding and other molten metal forms of joining.
- ◆ Applicable to cryofreezing of biological system (e.g. blood) where homogeneity is necessary. There are implications for human exploration missions.

## Development Approach:

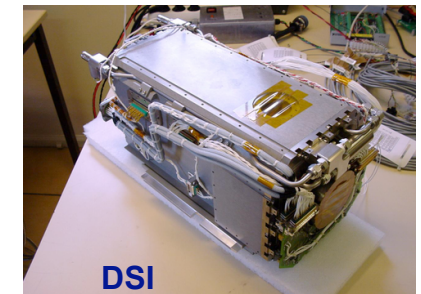
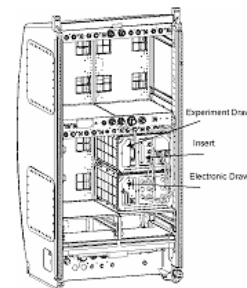
- ◆ Transparent alloy of succinonitrile will be used as an analog of metallic alloys.
- ◆ Sample will be observed by microscopy, interferometry with a resolution of 5 microns with a sampling rate – up to 25Hz.
- ◆ Samples can be re-run at various solidification rates and with various temperature gradients. US PI will select his own experimental conditions.

## Ground-based Research:

Development of cells to deep cells to dendrites, seen in directional solidification of a transparent plastic alloy analog. Low temperature furnace used. Pertinent data are overwhelmed by gravitational effects.



## ISS Resource Requirements



DECLIC - Dispositif pour l'Etude de la Croissance et des Liquide Critiques. Accommodation will be CNES's DECLIC equipment housed within an EXPRESS rack. DSI, Directional Solidification Insert will be used.